[0046] CLAIMS

What is claimed is:

1. A scalable audio coding apparatus comprising:

a signal processor for signal-processing input audio signals;

a quantizer for quantizing the signal processed input audio signals into quantized data of weighted subbands; and

an encoder for bit-plane coding the quantized data into an embedded audio bitstream of bit-planes, wherein:

the embedded audio bitstream includes binary data having bits;

each said bit-plane has a data unit that includes:

a beginning partition having one or more contiguous refinement bits;

a second partition having one or more contiguous coded significance bits;

a third partition having one or more contiguous sign boundary mark bits; and

a fourth partition having one or more contiguous coded sign bits;

the third partition is between the second and fourth partitions.

2. The scalable audio coding apparatus as defined in Claim 1, wherein each said data unit further comprises a last partition having dummy zeros, whereby the data unit is byte-aligned.

3. The scalable audio coding apparatus as defined in Claim 1, wherein:

the quantizer quantizes using a variable length coding algorithm having a finite code;

the bit-plane coding of encoder executes a predetermined coding method; and

the predetermined coding method generates the third partition as an invalid codeword for the predetermined coding method.

4. The scalable audio coding apparatus as defined in Claim 3, wherein the invalid codeword has a significant Hamming distance from valid codewords of the predetermined coding method.

5. A method for scalable audio coding of audio signals, comprising the steps of:

signal-processing input audio signals;

quantizing the signal-processing input audio signals into quantized data of weighted subbands; and

bit-plane coding the quantized data into an embedded audio bitstream of bit planes, wherein:

the embedded audio bitstream includes binary data having bits;

each said bit-plane has a data unit that includes:

a beginning partition having one or more contiguous refinement bits;

a second partition having one or more contiguous coded significance bits;

a third partition having one or more contiguous sign boundary mark bits; and

a fourth partition having one or more contiguous coded sign bits;

the third partition is between the second and fourth partitions.

6. The method as defined in Claim 5, wherein each said data unit further comprises a last partition having dummy zeros, whereby the data unit is byte-aligned.

7. The method as defined in Claim 5, wherein:

said quantizing quantizes using a variable length coding algorithm having a finite code;

the bit-plane coding executes a predetermined coding method; and

the predetermined coding method generates the third partition as an invalid codeword for the predetermined coding method.

8. The method as defined in Claim 7, wherein the invalid codeword has a significant Hamming distance from valid codewords of the predetermined coding method.

9. A computer-readable medium having computer-executable instructions, which when executed on a processor, direct a computer to perform the steps of Claim 5.

10. A computer usable medium having embodied thereon a computer program for coding audio signals into an audio bitstream, the computer program comprising:

a first code segment for signal-processing input audio signals;

a second code segment for quantizing the signal processed input audio signals into quantized data of weighted subbands;

a third code segment to affect bit-plane coding the quantized data into an embedded audio bitstream of bit planes, wherein:

the embedded audio bitstream includes binary data having bits;

each said bit-plane has a data unit that includes:

a beginning partition having one or more contiguous refinement bits;

a second partition having one or more contiguous coded significance bits;

a third partition having one or more contiguous sign boundary mark bits; and

a fourth partition having one or more contiguous coded sign bits;

the third partition is between the second and fourth partitions.

11. The computer program as defined in Claim 10, further comprising:

a fourth code segment to form a last partition of said data having dummy zeros, whereby the data unit is byte-aligned.

12. The computer program as defined in Claim 10, wherein:

the second code segment uses a variable length coding algorithm having a finite code to quantize the signal processed input audio signals into quantized data of weighted subbands;

the third code segment executes a predetermined bit-plane coding method; and

the predetermined bit-plane coding method generates the third partition as an invalid codeword for the predetermined bit-plane coding method.

13. The computer program as defined in Claim 12, wherein the invalid codeword has a significant Hamming distance from valid codewords of the predetermined bit-plane coding method.

14. A scalable audio decoding apparatus comprising:

a decoder to decode an embedded audio bitstream of bit-planes into quantized data of weighted subbands, wherein:

the embedded audio bitstream includes binary data having bits;

each said bit-plane has a data unit that includes:

a beginning partition having one or more contiguous refinement bits;

a second partition having one or more contiguous coded significance bits;

a third partition having one or more contiguous sign boundary mark bits; and

a fourth partition having one or more contiguous coded sign bits;

the third partition is between the second and fourth partitions;

an inverse quantizer to dequantize the quantized data of weighted subbands into audio signals.

15. The scalable audio decoding apparatus as defined in Claim 14, wherein each said data unit further comprises a last partition having dummy zeros, whereby the data unit is byte-aligned.

16. The scalable audio decoding apparatus as defined in Claim 14, wherein the decoder decodes using Reversible exponential Golomb (Exp-Golomb) codewords in a Reversible Variable Length Code (RVLC) algorithm.

17. The scalable audio decoding apparatus as defined in Claim 16, wherein the decoder:

decodes each said second partition having one or more contiguous coded significance bits using Reversible Exp-Golomb codewords that include a variable-length prefix part and a fixed-length suffix part;

performs error detection in the variable-length prefix of the coded significance bits in both forward and backward directions to detect an invalid codeword; and

identifies a location of the invalid codeword upon detection.

18. The scalable audio decoding apparatus as defined in Claim 17, wherein, upon identification of the location of the invalid codeword, the decoder:

compares a result of the error detection in the forward direction with a result of the error detection in the backward direction; and

accepts, for the decoding of the second partition, identical portions of the variable-length prefix of the coded significance bits as determined by the results of the error detection in the forward and backward directions.

19. A method for scalable audio decoding of an embedded audio bitstream into audio signals, comprising the steps of:

decoding an embedded audio bitstream of bit-planes into quantized data of weighted subbands, wherein:

the embedded audio bitstream includes binary data having bits;

each said bit-plane has a data unit that includes:

a beginning partition having one or more contiguous refinement bits;

a second partition having one or more contiguous coded significance bits;

a third partition having one or more contiguous sign boundary mark bits; and

a fourth partition having one or more contiguous coded sign bits;

the third partition is between the second and fourth partitions;

dequantizing the quantized data of weighted subbands into audio signals.

20. The method as defined in Claim 19, wherein each said data unit further comprises a last partition having dummy zeros, whereby the data unit is byte-aligned.

21. The method as defined in Claim 19, wherein the decoding uses Reversible Exp-Golomb codewords in a RVLC algorithm.

22. The method as defined in Claim 21, wherein the quantizing:

for each of said second partition having one or more contiguous coded significance bits uses Reversible Exp-Golomb codewords that include a variable-length prefix part and a fixed-length suffix part;

performs error detection in the variable-length prefix of the coded significance bits in both forward and backward directions to detect an invalid codeword; and

identifies a location of the invalid codeword upon detection.

23. The method as defined in Claim 22, wherein, upon identification of the location of the invalid codeword, the quantizing:

compares a result of the error detection in the forward direction with a result of the error detection in the backward direction; and

accepts, for the decoding of the second partition, identical portions of the variable-length prefix of the coded significance bits as determined by the results of the error detection in the forward and backward directions.

24. A computer-readable medium having computer-executable instructions, which when executed on a processor, direct a computer to perform the steps of Claim 19.

25. A computer usable medium having embodied thereon a computer program for decoding of an audio bitstream into audio signals, the computer program comprising:

a first code segment to decode an embedded audio bitstream of bit-planes into quantized data of weighted subbands, wherein:

the embedded audio bitstream includes binary data having bits;

each said bit-plane has a data unit that includes:

a beginning partition having one or more contiguous refinement bits;

a second partition having one or more contiguous coded significance bits;

a third partition having one or more contiguous sign boundary mark bits; and

a fourth partition having one or more contiguous coded sign bits;

the third partition is between the second and fourth partitions;

a second code segment to dequantize the quantized data of weighted subbands into audio signals.

26. The computer program as defined in Claim 25, further comprising a fourth code segment to form a last partition of said data unit having dummy zeros, whereby the data unit is byte-aligned.

27. The computer program as defined in Claim 25, wherein the decoding in the first code segment uses Reversible Exp-Golomb codewords in a RVLC algorithm.

28. The computer program as defined in Claim 27, wherein the decoding in the first code segment:

for each of said second partition having one or more contiguous coded significance bits, uses Reversible Exp-Golomb codewords that include a variable-length prefix part and a fixed-length suffix part;

performs error detection in the variable-length prefix of the coded significance bits in both forward and backward directions to detect an invalid codeword; and

identifies a location of the invalid codeword upon detection.

29. The computer program as defined in Claim 28, wherein, upon identification of the location of the invalid codeword, the quantizing:

compares a result of the error detection in the forward direction with a result of the error detection in the backward direction; and

accepts, for the decoding of the second partition, identical portions of the variable-length prefix of the coded significance bits as determined by the results of the error detection in the forward and backward directions.

30. A data structure for a coded bit-plane of an embedded audio bitstream that includes binary data having bits, the data structure comprising:

a beginning partition having one or more contiguous refinement bits;

a second partition having one or more contiguous coded significance bits;

a third partition having one or more contiguous sign boundary mark bits; and

a fourth partition having one or more contiguous coded sign bits, wherein the third partition is between the second and fourth partitions.

31. The data structure as defined in Claim 30, further comprising one or more zero stuffing bits into an end portion of the data structure, whereby the data structure is aligned with a respective byte.

32. A decoder of a codec that uses the data structure defined in Claim 30 to:

decode the embedded audio bitstream of bit-planes into quantized data of weighted subbands; and

dequantize the quantized data of weighted subbands into audio signals.

33. The decoder as defined in Claim 32, wherein the decoder decodes using Reversible Exp-Golomb codewords in a RVLC algorithm.

34. The decoded as defined in Claim 33, wherein the decoder:

decodes each said second partition having one or more contiguous coded significance bits using Reversible Exp-Golomb codewords that include a variable-length prefix part and a fixed-length suffix part;

performs error detection in the variable-length prefix of the coded significance bits in both forward and backward directions to detect an invalid codeword; and

identifies a location of the invalid codeword upon detection.

35. The decoder as defined in Claim 34, wherein, upon identification of the location of the invalid codeword, the decoder:

compares a result of the error detection in the forward direction with a result of the error detection in the backward direction; and

accepts, for the decoding of the second partition, identical portions of the variable-length prefix of the coded significance bits as determined by the results of the error detection in the forward and backward directions.

36. An encoder of a codec that forms the data structure defined in Claim 30 by:

signal-processing input audio signals;

quantizing the signal processed input audio signals into quantized data of weighted subbands; and

bit-plane coding the quantized data into an embedded audio bitstream of bit planes.

37. A system comprising:

a client computer coupled to a network; and

a server computer coupled to transmit an embedded audio bitstream of bit-planes to the client computer via the network, wherein the embedded audio bitstreams of bit-planes has a data unit that includes:

a beginning partition having one or more contiguous refinement bits;

a second partition having one or more contiguous coded significance bits;

a third partition having one or more contiguous sign boundary mark bits; and

a fourth partition having one or more contiguous coded sign bits, wherein the third partition is between the second and fourth partitions.

38. The system as defined in Claim 37, wherein client computer comprises a codec including a decoder to:

decode the embedded audio bitstream of bit-planes into quantized data of weighted subbands, and

dequantize the quantized data of weighted subbands into audio signals.

39. The system as defined in Claim 38, wherein when the decoder decoding using Reversible Exp-Golomb codewords in a RVLC algorithm.

40. The systems as defined in Claim 39, wherein the decoder:

decodes the second partition having one or more contiguous coded significance bits using Reversible Exp-Golomb codewords that include a variable-length prefix part and a fixed-length suffix part;

performs error detection in the variable-length prefix of the coded significance bits in both forward and backward directions to detect an invalid codeword; and

identifies a location of the invalid codeword upon detection.

41. The system as defined in Claim 40, wherein, upon identification of the location of the invalid codeword, the decoder:

compares a result of the error detection in the forward direction with a result of the error detection in the backward direction; and

accepts, for the decoding of the second partition, identical portions of the variable-length prefix of the coded significance bits as determined by the results of the error detection in the forward and backward directions.